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ABSTRACT

The effects of syllable timing and syllable sequence type on vowel sandhi in Spanish are investigated in this paper. It is argued that structuralist and generative treatments of vowel sandhi, which are characterized by generalizations about vowel "shortening" and dropping and glide formation, are inadequate because they focus exclusively on segmental phenomena. These analyses ignore the interplay between suprasegmental and segmental phenomena. Generative analyses are also forced to a rule-ordering strategy that, it is argued, is inappropriate for the level of the derivation where the rules apply. The analysis offered here, supported by phonetic evidence, accounts for syllable timing and syllable sequence type, thereby allowing one general statement about the segmental changes that contiguous vowels undergo in sandhi. This eliminates the need for a rule-ordering strategy. The present analysis shows vowel sandhi to be a consequence of suprasegmental timing and syllable sequence type imposed over a two-syllable domain. (Author/KM)

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Spanish Vowel Sandhi¹
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The effects of syllable-timing and syllable sequence type on vowel sandhi, a much described type of liaison found in Spanish, are investigated in this paper. Spanish is a syllable-timed language.² This means that the syllable is the unit of tempo and that syllable length is kept fairly constant, independent of stress. Sentence (1) contains three examples of vowel sandhi. Notice that in each case, two contiguous syllable peaks across word boundaries are pronounced as one in conversational Spanish.

- (1) Su amante vive en una casa (h)umilde.
swa-mán-te-~~fi~~-pe-nu-na-ka-su-míl-de³
Her lover lives in a modest house.

Structuralist and Generative treatments of vowel sandhi are characterized by generalizations about vowel "shortening", vowel dropping, and glide formation. I hope to show that these analyses are inadequate because they focus exclusively on segmental phenomena, ignoring the interplay between suprasegmental and segmental phenomena. Generative analyses are also forced to a rule ordering strategy which I will argue is inappropriate for the level of the derivation where the rules apply. I offer, instead, an analysis, supported by phonetic evidence, which accounts for syllable-timing and syllable sequence type, thereby allowing one general statement about the segmental changes which contiguous vowels undergo in vowel sandhi. This eliminates the need for a rule ordering strategy.

Given vowel sandhi, the first question is: is there a syllable sequence type which is constant in Spanish?

Navarro Tomas (1968) lists the phonetic syllable types⁴ in order of frequency: CV - 58.45%, CVC - 27.35%, V - 5.07%, CCV - 4.70%, VC - 3.31%, CCVC - 1.12%. Comparing the percentages for CV syllables (58.45%) and for CCV syllables (4.70%) on the one hand, and the percentages for CV syllables (58.45%) and for V syllables (5.07%) on the other hand, one can conclude that Spanish tends to have syllable sequences with few consonant clusters and few vowel clusters i.e., Spanish tends to have syllable sequences which approximate a CVCVCV... sequence. The reduction of contiguous syllable peaks across word boundaries as seen in sentence (1) seems natural because vowel sandhi is contributing to the tendency Spanish has for a certain syllable sequence type.

Vowel sandhi may, therefore, be triggered by contiguous vowels, but the process which accomplishes the reduction is controlled by syllable-timing. A syllable-timed language like

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Spanish tends to hold syllable length constant. This means that it is not only contiguous vowels which are collapsed in vowel sandhi but the consonants surrounding them as well. That is, two entire contiguous syllables of a specified type, as shown below, must be collapsed within the unit length allotted to one syllable. Notice that the resulting syllable, which is CV(C), has a complex vowel nucleus.

(2) su amante
swa-mán-te

(3) tuyo absolutamente
tú-ywa-~~s~~-so-lu-ta-mén-te

The formation of a new vowel nucleus is dependent on the standard syllable length for any one utterance which in turn is dependent on speech style. Harris (1969) recognizes four distinct speech styles in Spanish which depend on the rate of speech. Two of them are of interest here: andante "a moderately slow, careful, but natural" speech and allegretto "a moderately fast, casual, colloquial" speech.

What follows is a description of the formation of new vowel nuclei through vowel sandhi for a dialect of Spanish spoken in South Texas. Vowel sequences are divided into two groups according to stress placement: Group I (VV, VV') and Group II (VW). They are further divided into identical and non-identical contiguous vowels. First, Group I will be discussed, starting with identical contiguous vowels. Later, non-identical contiguous vowels will be discussed. Following that, Group II will be discussed similarly. In general, in andante speech, the first of the two vowels undergoes "shortening". In allegretto speech, the first of the two vowels undergoes "dropping" or "glide formation". All of the examples are from allegretto speech.

Group I (VV, VV')

Identical contiguous vowels fall together. In andante speech, the vowel seems longer than it does in allegretto.

Examples:

(4) lo odio lóoyo
(5) le hechas lécas
(6) mi hijo míxo

(7) tu uniforme tunifórme
(8) era así érasí

The first of non-identical contiguous vowels is (a) shortened or made a glide, or (b) shortened or dropped.

(a) high or mid vowels, except e in ei sequences and o in ou sequences, are shortened or made glides.

Examples:

(9) mi ultima	myúltima	(16) tengo hipo	teḡwípo
(10) tu hijo	twíxo	(17) pague ocho	payóco
(11) mi hebra	myéβra	(18) como Eva	komwéβa
(12) tu epoca	twépoka	(19) porque aveces	porḡyaβéses
(13) mi obra	myóβra	(20) lo habla	lwáβla
(14) su Homero	swoméro	(21) me urge	myurxe
(15) mi arbol	myárβol	(22) tu alma	twálma

Exceptions: in ei and ou sequences, the first vowel is shortened or dropped.

Examples: (23) se hinca síḡka (24) como uvitas komuβítas

(b) a, a low central vowel, is shortened or dropped.

Examples:

(25) esta hija	estíxa	(28) casa humilde	kasumílde
(26) la iglesia	liḡlésya	(29) paga Evita	payeβíta
(27) la ultima	lúltima	(30) niña orgullosa	niñorḡyúsa

Group II (VV)

When the first of two contiguous vowels is stressed, the stress shifts to the second vowel in allegretto speech. Identical contiguous vowels fall together. In andante speech, the vowel seems longer than it does in allegretto.

Examples:

(31) contó hormigitas	kontòrmixítas	(35) Mamá habrá	mamáβrá
(32) conté elefantes	kontèlefantes		
(33) comí higaditos	komíyaβítos		
(34) Cantú hubiera	kantúpyéra		

The first of non-identical contiguous vowels is (a) shortened or made a glide, or (b) shortened or dropped.

(a) high or mid vowels, except e in ei sequences and o in ou sequences, are shortened or made glides.

Examples:

(36) ví elotes	byelótes	(44) Cantú imita	kantwímíta
(37) comí uvitas	komyúβítas	(45) Cantú echaba	kantwečáβa
(38) Cantú opina	kantwópina	(46) comí ochenta	komyóčenta
(39) habló Evita	aplwèβíta	(47) hablé a tiempo	aplyàtyémpo
(40) habló Adan	aplwáβán	(48) pagué ochenta	payóčenta
(41) ví arbejas	byàrβéxas	(49) Cantú hablara	kantwàβlará
(42) tomó ingles	tomwíḡglés		
(43) canté humildemente	kantyùmildeménte		

Exceptions: in ei and ou sequences, the first vowel is shortened or dropped.

Examples: (50) sé ingles singlés (51) cortó uvitas kortupitas

(b) a, a low central vowel, is shortened or dropped.

Examples:

(52) vendrá Inez bendrines (54) vendrá Humberto bendrumberto
(53) Papá evitaba papepita a (55) vendrá Homero bendromero

The weakening of the first of the two contiguous vowels in vowel sandhi is consistent with the tendency Spanish has for a certain type of syllable sequence i.e., a CVCVCV... sequence. In such a sequence, each syllable has a crescendo-like increase of energy, and parallel to this, each starts with some degree of constriction or closure, proceeding to maximum aperture. When a CV#V(C) sequence is collapsed within the unit length allotted to one syllable in allegretto speech, if it is the first of the two contiguous vowels which is dropped or made a glide, instead of the second, the closure-to-aperture, crescendo-like energy distribution characteristic of the CVCVCV... syllable sequence is maximized.

A final question about Spanish vowel sandhi remains to be discussed. In what way do shortening and stress shift (due to syllable sequence type and syllable-timing) cause vowel dropping or glide formation of the first of the two contiguous vowels in a CV#V(C) sequence, when that sequence is collapsed in allegretto speech? The question will be answered in part by a discussion of the results of spectrograms made from a recording of 52 utterances in allegretto speech containing the above examples of vowel sandhi.

The data discussed earlier indicate that in allegretto speech identical vowels fall together, and the first of two contiguous non-identical vowels is dropped or made a glide. It seems natural that identical vowels in a CV#V(C) sequence should fall together when that sequence is collapsed since, articulatorily, no transition is needed to go from one to the other. The vowel sandhi spectrograms show that the new vowel nucleus has a steady state formant structure and that regardless of its initial stress configuration (VV, VV', VV) it has the duration of a single stressed syllable nucleus.

ei and ou sequences act differently. The spectrograms show that if the initial stress configuration consists of two unstressed vowels (VV), the duration of the new syllabic nucleus will be that of a single unstressed vowel. Otherwise, the duration of the new syllabic nucleus will be that of a single stressed vowel. The spectrograms also show phonetic variation within allegretto speech. For example, Ce#i(C) sequences range within two extremes: (a) Cei(C), where e is a short shallow on-

glide transition to the following i and (b) Ci(C), where i is a steady state vowel. Speakers perceive all of these variations as Ci(C) sequences. In articulatory terms, it is possible that the on-glide target for e approaches that of a y glide. If so, the ei sequence may be a special case of identical vowels falling together. The same explanation would hold for ou sequences.

When a Ca#V(C) sequence is collapsed in allegretto speech, a is dropped. The vowel sandhi spectrograms show that Ca#V(C) sequences behave in a parallel way to ei/ou sequences. The new syllabic nucleus will vary in duration depending on the initial stress configuration of the sequence and there is a similar range of phonetic variation which speakers do not perceive. Perkell (1969) offers information about the movement of the jaw and the body of the tongue in the production of high and mid vowels as contrasted with the production of low vowels which might explain the dropping of a and the glide formation of the high and the mid vowels in Spanish vowel sandhi. He finds that jaw movement plays an important role in the production of a, influencing tongue height, larynx height, and lip shape. In the production of a CV syllable, at 100 msec. from consonant release, the distance between the tongue height in the production of i and the tongue height in the production of a is 1.5 cm. - i being the high vowel, a being the low vowel. Likewise, the distance between the jaw height in the production of i and in the production of a is .5 cm. The jaw height in the production of all consonants is level with that found in the production of i.

Perkell notes that jaw movement is sluggish and its control must be anticipated if it is an essential part of an articulatory gesture. Because of this sluggishness, jaw movement tends to vary slowly and to be of diminished amplitude in continuous speech.

Given that the jaw height for consonants is level with that of high vowels, and given the sluggishness of jaw movement and its importance in the articulation of a, it is likely that there is an increased loss of articulatory amplitude in the production of a CaV(C) sequence as one approaches the most casual extreme of allegretto speech. The necessity of moving from the high jaw position required of the consonant through the low jaw, low tongue position required for the shortened a, to the higher jaw position of the following strong vowel may not be possible within the time constraints of allegretto speech. These articulatory relationships may explain why a is dropped but the high and mid vowels are made glides in Spanish vowel sandhi.

It is interesting that speakers do not perceive the range of phonetic variation for Ce#i(C), Co#u(C), and Ca#V(C) sequences in allegretto speech. Experiments by Hirsh (1959), Broadbent and Ladd (1959), and Fay (1966) show that there are constraints on the perception of contiguous sounds. Shortening the

first sound can obscure the presence of two separate sounds as well as the order in which the sounds are perceived. In vowel sandhi, it is the first of the two contiguous vowels which is shortened and this shortening may be obscuring the presence of a in Ca#V(C) sequences. However, it is not obscuring the presence of, for example, the high vowel in a Ci#o(C) sequence. High and mid vowels seem to be perceived differently than the low vowel in these circumstances. The reason may be that Spanish has y and w glides but not a glides elsewhere in the language. Speakers may, therefore, be attuned to short i-like items as on-glide transitions to another vowel but they may react to the short a-like item as though it were not there. There seem to be, then, articulatory and perceptual reasons for the differences due to shortening between the high and mid vowels, and the low vowel when these are the first of the two contiguous vowels in CV#V(C) sequences during allegretto speech.

The fact that speakers do not perceive the phonetic variation found in the production of Ce#i(C), Co#u(C), and Ca#V(C) sequences in allegretto speech suggests that vowel sandhi is a phonetic phenomenon whose domain is greater than the segment. Vowel sandhi is not a case of segmental alternation but the consequence of suprasegmental timing and syllable sequence type imposed over a two syllable domain i.e., CV#V(C). A grammar of Spanish should relate the following language specific phenomena:

1. syllable-timing - syllable length is to be kept fairly constant independent of stress. Tempo may vary from andante to allegretto.

2. syllable sequence type - syllable sequences should approximate a CVCVCV... sequence.
3. vowel sandhi - conforming to the unit length allotted to one syllable in a specific utterance - a CV#V(C) sequence must have its syllabic energy concentrated over the second vowel with accompanying weakening i.e., shortening and stress removal, if any, of the first.

Generative analyses of contiguous vowels have focused on the segmental changes. Below, is a set of crucially ordered rules which presumably account for the data discussed earlier. These rules are similar in their ordering strategy to those used by Contreras (1969) in a description of Chilean Spanish.

Generative Rules for Vowel Sandhi in Spanish

1. vowel shortening

$$V \rightarrow [n\text{-short}] / \_\_\_\# V \quad \text{andante}$$
2. stress shift

$$V \quad \# \quad V \Rightarrow V \quad \# \quad V$$

$$[+stress] \quad \quad \quad [+stress] \quad \text{allegretto}$$

$$1 \quad 2 \quad 3 \quad \quad 1 \quad 2 \quad 3$$

3. identical-vowel dropping

$V \rightarrow \emptyset / \_\_\_\# V$
 $[\neg F] \quad [\neg F]$ allegretto

4. a-dropping

$V \rightarrow \emptyset / \_\_\_\# V$
 $[+low]$ allegretto

5. mid vowel dropping

$V \rightarrow \emptyset / \_\_\_\# V$
 $[\neg back] \quad [+high] \quad [\neg back]$ allegretto

6. glide formation

$V \rightarrow [-vocalic] / \_\_\_\# V$ allegretto

Sample Derivations: only derivations for allegretto are given.

Input: (4) lo#óyo (26) la#iylésya (23) se#íyka (37) komí#upítas

rule 1	-	-	-	-
2	-	-	-	komí#upítas
3	l#óyo	-	-	-
4	-	l#iylésya	-	-
5	-	-	s#íyka	-
6	-	-	-	komy#upítas
Output:	lóyo	liylésya	síyka	komyupítas

Notice that rules 3-6 are in a bleeding relationship. That is, rule 3 bleeds rules 4-6, rule 4 bleeds rules 5 and 6, and rule 5 bleeds rule 6. Specifically, each rule changes a two vowel sequence so that it will not satisfy the environmental conditions of rule 6. Derivations (23), (26), and (37) illustrate this. Furthermore, only rules 3 and 4 are not crucially ordered. Even so, in a derivation for the sequence era asi rule 4 bleeds rule 3.

Bleeding orders are said to be marked because languages tend to reorder rules which are in a bleeding relationship in order to maximize their application within the grammar. However, Kenstowicz and Kisseberth (1971) have found cases where bleeding orders are unmarked. They show that rules which affect underlying syllable structure naturally bleed rules which crucially refer to surface syllable structure. Given their findings, the above rules for vowel sandhi might, at first glance, seem to be a set of rules with an unmarked bleeding order. However, that is not the case. The examples given by Kenstowicz and Kisseberth show clearly that they are talking about an underlying abstract syllable structure. Therefore, an unmarked bleeding order is expected since their epenthesis, copying, and metathesis rules are abstract and their assimilation and neutralization rules are concrete. Their ideas stem not from rule ordering but from the notions abstract and concrete.

Whereas, in Spanish, the input representations to each of the vowel sandhi rules are surface phonetic structures. The phonetic n-ary feature, andante rule supports this. But given

the form of the allegretto rules, one would think there is no relation between andante and allegretto speech and conclude that perhaps vowel sandhi occurs at a different level in the derivation for allegretto than for andante speech. This obscures any generalization that might be made about vowel sandhi across speech styles.

Furthermore, the stress shift, vowel dropping, and glide formation rules do not explain vowel sandhi. Together, the rules form a list of individual segmental changes and, as in the case of rule 4, there are some rather inexplicable changes. Rule 4 seems unnatural because it is not motivated by any generalization relating it to any of the other segmental changes. These rules do not allow the generalization that an energy distribution, which is controlled by syllable-timing and syllable sequence type, takes place over a domain larger than the segment. They ignore the relationship between suprasegmental and segmental phenomena, a relationship I have shown above is necessary for an understanding of Spanish vowel sandhi.

Footnotes

1. I want to thank Robert Harms and Peter MacNeilage for their comments on earlier versions of this paper. A special note of thanks is due Ilse Lehiste whose work on and ideas about suprasegmentals have been extremely helpful. Any errors of fact or interpretation are my responsibility.
2. Previous studies in phonetics - Delattre (1966), Navarro Tomas (1968), and Hutchinson (1973) have found that English has a durational ratio between stressed and unstressed syllables of approximately 1.6, while that of Spanish is 1.3. This is one of the durational characteristics which allow English to be described as a stress-timed language while Spanish is described as a syllable-timed language.
3. In order to preserve legibility all square brackets have been omitted from the phonetic representations. I give the orthographic representation to the left and the surface phonetic representation to the right except for examples (1), (2), and (3). In those cases, the orthographic representation comes above the surface phonetic representation.
4. The following symbols are used throughout the paper:
C - consonant, G - glide, and V - vowel.

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